DOCUMENT RESUME

ED 210 637 CS 006 384

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TITLE Vocabulary Instruction in Mathematics: Do the "Little" Words Count?
PUB DATE Dec 81
NOTE 9p.: Paper presented at the Annual Meeting of the American Reading Forum (2nd, Sarasota, FL, December 10-12, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Content Area Reading; Educational Games; Intermediate Grades; *Mathematics Instruction; *Reading Comprehension; *Reading Research; *Vocabulary
IDENTIFIERS *Word Problems

ABSTRACT

A study was conducted to determine whether vocabulary instruction in the "little" words would enhance children's performance on mathematical word problems. Thirty-eight fourth, fifth, and sixth grade students were pretested in mathematics computation and were assigned to experimental or control groups. The control groups received drill in basic addition, subtraction, multiplication, and division facts while the experimental groups received instruction in the meanings of 50 vocabulary words, such as "the," "is," "page," "number," and "do." The meanings of the vocabulary words were discussed and recorded, and occasionally a game was played to reinforce the word meanings. At the end of three weeks all students were posttested and the pretest-posttest scores were compared for the entire group. Comparison scores indicated that the students as a whole made significant gains. When posttest scores for the experimental and control groups were compared, no significant differences were found, although the mean of the experimental group was 3.6 months higher than that of the control group. Drill on basic addition, subtraction, multiplication, and division facts was no more effective in improving mathematics computation than was vocabulary instruction. (A list of the 50 "little" vocabulary words and their meanings is included.) (HTH)

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Vocabulary Instruction in Mathematics: Do the "Little" Words Count?

Paper Presented at:
The American Reading Forum Conference
December 10, 1981

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Vocabulary Instruction in Mathematics: Do the "Little" Words Count?

Introduction

Many researchers have noted the importance of teaching students the vocabulary and concepts needed in the various content areas including mathematics. Taschow (1969) noted that Gray and Holmes found that even small amounts of direct and planned teaching of terms and concepts produced "dramatic" results in terms of comprehension and content field knowledge. John (1947) suggested that the meaning of mathematical terms such as "tangent" and "ratio" must be taught. Investigators such as Willmon (1971) and Kane, Byrne, and Hater (1974) have studied the vocabulary needed in mathematics. The emphasis of such investigators has been technical vocabulary. Yet, as Dunlap and McKnight (1978) noted, there are three levels of mathematical vocabulary: the general, the technical, and the symbolic. The general and symbolic have been somewhat neglected. Perhaps it is assumed that knowledge of the general vocabulary will come from everyday experiences. However, Phillips (1979) noted that the correct interpretation of "little" words (from the general vocabulary class) is a major cause of difficulty in mathematics. Sullivan (1980) identified 50 words that comprised 51% of a sample of 44,394 words from selected K-6 grade mathematics texts. Most of these words represented "little" words from the general vocabulary class such as "the", "of", "to", "is", "a", "and", "in", and "at". But, does teaching students the meanings of "little" words from the class of general vocabulary enhance mathematics performance? The purpose of this study was to find out.

Procedures

Thirty-eight fourth, fifth, and sixth grade students attending a three week summer mathematics enrichment program served as subjects in this study. The students received mathematics instruction for two hours a day, each day of the three week period. Initially, all students were tested on mathematics computation using the Metropolitan Achievement Test, Intermediate Level. Based on their performance, students were assigned to one of four groups. Each group received daily instruction on mathematics computations and concepts for a period of one-half hour. Another half-hour was spent working individually on skills cards, another half-hour was spent on a fun math activity, and a fourth half-hour was spent on the control or experimental treatment. Students were assigned to the experimental or control group on the first day. Comparison of the pretest scores on the Metropolitan for the experimental and control groups indicated no significant difference ($t_{(36)} = .187$; NS). The pretest mean of the experimental group was 5.19 and the mean of the control group was 5.12. The control group received drill on basic addition, subtraction, multiplication, and division facts while the experimental group received instruction on the meanings of 50 vocabulary words. The words and their meanings are contained in Table 1. The meanings of the vocabulary words were discussed and recorded. Occasionally a game was played to reinforce the word meanings. Two informal tests were given to check students' retention of word meanings. The four groups rotated their activities so that during any half-hour no two groups were involved in the same activities.

On the last day of the program all students were posttested on mathematics computation. Pretest-posttest scores were compared for the entire group. Posttest scores for the experimental and control groups were also compared by means of a t-test. As suggested by Gay (1981) if groups are essentially the same on the pretest, posttest scores can be directly compared using a t-test.

Table 1

Vocabulary Words and Their Meanings

Word	Meaning
the	one specific thing
is	equals .
a	any one thing
are	equals
can	able
on	on top of and under
page	one sheet in a book
who	question asking about someone
find	figure
one	idea in the head that stands for more than 0 and less than 2
ones	position; in a figure, the numeral to the far right
ten	idea in the head that stands for more than 9 and less than 11
tens	position; in a figure, the numeral to the left of the ones
hundred	idea in the head that stands for more than 99 and less than 101
hundreds	position; in a figure, the numeral to the left of the tens
and	something more, do both
or	either this or that but not both
number	idea in the head
numeral	sign or symbol used to stand for a number
how	question word asking for step or steps
many	amount, contrasted to few

Table 1 (Cont.)

Word	Meaning
how many	question asking for the number of something
what	question asking for things as opposed to persons
you	contrast to me, statement directed to you
your	contrast to mine, shows ownership
we	group including self, usually the subject of the sentence
it	contrast to he/she, in math refers to problem or thing
look	command to put eyes on and allow brain to react
write	put pencil in hand and make mark, symbol, etc. not write in cursive
each	every single one
numbers	ideas in the head
this	specific one in close location
that	contrast to this, specific but not in close location
set	group of things with something in common
us	group including self, usually the object of the sentence
there	contrast to here, not in close location
which	question that implies a choice
do	work or figure
same	alike, not different; equal in meaning
exercises	problems, not physical activities
these	contrast to those, more than one in close location
first	contrast to then, usually means spatial e.g. first in line; in math has to do with time e.g. do this first

Table 1 (Cont.)

Word	Meaning
have	contrast to have not or had, hold in one's possession
here	contrast to there, here is in close location
times	multiply; in "How many times" may mean the number of trials or performances
has	possession of, singular form
all	everything or everyone
equals	is, are, or the same amount on both sides

Results and Discussion

Comparison of pretest and posttest scores indicated that the students as a whole made significant gains ($t_{(37)} = 5.72$; $p<.001$). The mean of the posttest was 6.6 months higher ($\bar{X} = 5.81$) than the mean of the pretest ($\bar{X} = 5.15$). When posttest scores for the experimental and control groups were compared no significant difference was found ($t_{(36)} = .87$; NS). However, the mean ($\bar{X} = 5.98$) of the experimental group was 3.6 months higher than the mean ($X = 5.62$) of the control group. Although not significant, a difference of 3.6 months in three weeks time seems promising. Perhaps with additional time to insure that the meanings of the words had been mastered, gains would have been significant. This possibility is being explored in a follow-up study.

It is interesting to note that drill on basic addition, subtraction, multiplication, and division facts which many teachers believe is necessary was no more effective than vocabulary instruction in improving mathematics computation.

When the reading specialist is asked by the mathematics teachers what can be done to help students read mathematics the discussion almost always turns to word problems and ways of helping students comprehend word problems. The results of this study would seem to indicate that helping mathematics teachers teach their students the meanings of the "little" general vocabulary words used in mathematics textbooks and suggested in the teacher's manuals for use in presenting lessons certainly would not be detrimental to mathematics achievement. Direction instruction supplemented by discussions and games could be used.

As noted, this study is being replicated over a longer period of time to allow sufficient time to insure mastery of the words. Preliminary results indicate the experimental group has made significant gains over the control group.

Although further study is needed on a variety of populations, it appears that reading specialists may assist math teachers with more than word problems. Teaching the students the meanings of the general vocabulary used in mathematics is at least as effective as drill on basic facts and may yet be shown to be more effective.

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